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1 **Implementation of the *Activate* injury prevention exercise programme in**  
2 **English schoolboy rugby union**

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16  
17 **Word Count: 3070**

18 **ABSTRACT**

19 **OBJECTIVES**

20 The implementation of the *Activate* injury prevention exercise programme has not been assessed in an applied  
21 context. This study aimed to 1) describe the knowledge and perceptions of school rugby coaches and players  
22 towards injury risk, prevention and *Activate*, 2) evaluate *Activate* implementation in schoolboy rugby using the  
23 RE-AIM framework.

24

25 **METHODS**

26 Bespoke electronic surveys were administered to coaches (including support staff) and players at participating  
27 English schools (2018-2020). Most questions and statements were answered using a 7-point Likert scale. At  
28 baseline, participants detailed their *Activate* awareness and perceptions of injury risk and prevention in  
29 schoolboy rugby. At post-season, participants reported *Activate* use throughout the study and their perceptions  
30 towards the programme.

31

32 **RESULTS**

33 At baseline, significant differences existed between coaches (n=106) and players (n=571) in *Activate* awareness  
34 (75% and 13% respectively;  $\chi^2=173.5$ ,  $p<0.001$ ). Coaches perceived rugby had a significantly greater injury risk  
35 than players, whilst holding more positive perceptions towards injury prevention. At post-season, coaches  
36 reported greater *Activate* adoption compared to players (76% and 18% respectively;  $\chi^2=41.8$ ,  $p<0.001$ ); 45% of  
37 players were unaware if they used the programme. Median session adherence was twice weekly, with a median  
38 duration of 10-15 minutes. This suggests *Activate* was not implemented as intended, with recommendations of  
39 three 20-minute sessions per week. Both groups identified common barriers to implementation, such as lack of  
40 time and inclusion of a ball.

41

42 **CONCLUSION**

43 Coaches are instrumental in the decision to implement *Activate*. Targeting behaviour-change in these  
44 individuals is likely to have the greatest impact on intervention uptake.

45

46 **WHAT ARE THEY KEY FINDINGS?**

- 47
- 48 • Coaches reported significantly greater baseline *Activate* awareness than players (75% and 18%  
49 respectively).
  - 50 • Coaches had significantly greater *Activate* adoption during the study period (76% and 13%).
  - 51 • Coaches appear to be critical in the adoption and delivery of *Activate* in a school rugby environment.
  - 52 • Focus on behaviour change in coaches will likely have the greatest effect of *Activate* implementation.  
53 Addressing coach barriers and using behaviour change theories may aid this.

55 **INTRODUCTION**

56 The Rugby Football Union (RFU), England's rugby union governing body, have been championing the *Activate*  
57 injury prevention exercise programme. The 20-minute warm-up, designed to be completed prior to training  
58 and matches, has shown to be efficacious in reducing youth rugby injury risk.(1) There are three age-group  
59 specific programme available, under-15/16/18, incorporating balance, resistance and plyometric exercises with  
60 four progressive phases to be completed throughout the season.(1, 2) In a randomised controlled trial of English  
61 schoolboy rugby (under-15 to under-18 years old), a 72% reduction in overall match injuries and a 59%  
62 reduction in concussions were reported in teams maintaining full compliance through a season ( $\geq 3$  times per  
63 week). However, only 16% of teams in the intervention arm completed *Activate* as prescribed. If highly  
64 resourced schools, supported by a research team, could not maintain compliance over a single season, it raises  
65 questions regarding *Activate's* longer-term effectiveness given the complexity of implementing such  
66 interventions in broader sporting contexts.(3, 4)

67  
68 Injury prevention programmes across various sports have been impacted by poor implementation.(5-7) The  
69 *11+* (previously '*FIFA 11+*') is perhaps the most widely evaluated programme, with meta-analyses revealing a  
70 20-70% reduction in injury rates across various settings.(8-10) However, in 2015 only 10% of national football  
71 associations endorsed the programme.(11) Low end-user awareness and adoption have been reported  
72 worldwide,(12-14) highlighting the difficulty in successfully disseminating and implementing such  
73 interventions.(4) Numerous contextual complexities influence the transfer of findings from research to practice,  
74 including individual perceptions, social influences, political pressures and physical demands.(15-17) Many of  
75 these factors are not evaluated in research or addressed in practice, possibly due to the misconception that  
76 people will automatically adopt efficacious interventions because injury prevention is of high priority.(18, 19)

77  
78 Evaluating influences on end-user behaviour is a critical step towards successful implementation.(3) This is  
79 particularly important in community-based environments where users may be volunteers, lack adequate  
80 training, or are constrained by time and resources.(20) One tool used to evaluate the implementation of public  
81 health interventions is the RE-AIM framework.(21) Briefly, the framework assesses an intervention through five  
82 dimensions (table 1); reach (R), effectiveness (E), adoption (A), implementation (I) and maintenance (M), with  
83 barriers and facilitators occurring at each dimension. Sport-specific modifications have been recommended to  
84 the original framework,(22) including evaluating each dimension at different hierarchical levels (e.g., coaches  
85 and players) because differences in knowledge, perceptions and contextual factors at different levels can  
86 influence intervention implementation. This was highlighted in a population of South African schoolboy rugby  
87 coaches and players, where awareness and knowledge of the *BokSmart* injury prevention programme  
88 significantly differed between these two groups.(23) RE-AIM suggests that for interventions to have their  
89 desired impact, they need to be well known, adopted and implemented over prolonged periods. This is relevant  
90 for sports injury prevention programmes,(1, 24) yet research heavily focuses on effectiveness with little  
91 assessment of the remaining dimensions.(25, 26) Only efficacy has been assessed for *Activate* in school  
92 rugby.(1)

93  
94 End-user perceptions influence injury prevention behaviours,(3) thus evaluating these in school rugby coaches,  
95 support staff, and players would provide valuable information to aid *Activate* implementation. Therefore, this  
96 study's objectives were to 1) describe and compare baseline knowledge and perceptions of rugby union coaches  
97 (including support staff) and players towards injury risk, injury prevention and *Activate*; and 2) evaluate  
98 *Activate's* 'reach', 'adoption', 'effectiveness', 'implementation' and 'maintenance' in English schoolboy rugby.

99  
100 **METHODS**101 **Pre-study *Activate* Implementation**

102 Following publication of an efficacy study in July 2017,(1) the RFU began disseminating *Activate* through online  
103 resources and coach development events, offering free regional training workshops for coaches and support  
104 staff registering their interest on the RFU website. In 2018, regional workshops were replaced by a "workshop  
105 on request" system and all online resources became openly available and immediately downloadable on the  
106 website with no need to register. School coaches were free to take part in these activities, but schools were not  
107 specifically targeted through advertising campaigns or workshop deliveries prior to the 2018 season. *Activate*

108 dissemination and implementation was completed by the RFU. No information is available regarding the  
109 number of website registrations or workshops run by the RFU external to this study.  
110

### 111 **Recruitment**

112 The research team compiled a comprehensive, but not exhaustive, database of English schools (n=289). School  
113 names were retrieved from the RFU website for those participating in under-12 to under-19 competitions. Email  
114 addresses were obtained for school rugby staff members whom possibly influenced team warm-up procedures  
115 (directors/heads of rugby, assistant coaches, medical staff, conditioning staff). Additionally, the RFU publicised  
116 the study through coach correspondence and social media to aid recruitment, directing potential participants  
117 to contact the research team. School rugby seasons started between July-September and finished between  
118 December (generally independent schools) and April (government funded state schools). Recruitment emails  
119 were sent inviting schools to join the project in pre-season of two consecutive seasons (July-September 2018  
120 and 2019). If a response to the initial recruitment email was not received, a follow up email was sent two weeks  
121 later, after which it was accepted that the school did not wish to participate.  
122

123 At participating schools, a gatekeeper (primarily the coach) was sent electronic links  
124 (<https://www.onlinesurveys.ac.uk/>) to information sheets and consent forms to forward onto team staff  
125 (hereby referred to as coaches), players and their parents/guardians. Ethical approval was gained from the  
126 University of Bath (EP 17/18 167). Patients and public were not involved in the study design.  
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### 128 **Baseline measures**

129 Participants were asked to complete an online baseline survey detailing: A) demographics, B) perceptions of  
130 injury risk in rugby, C) perceptions of injury prevention in rugby, and D) *Activate* awareness (Supplementary file  
131 1). The coach survey included 26 questions. A refined player survey (13 questions) was used to maximise  
132 response rates, containing questions that were re-worded to enable comprehension by the youngest  
133 participants (Flesch reading ease score = 6.7).  
134

135 Questions in sections B, C and D were taken from studies investigating end-user perceptions and intentions  
136 towards the *11+*.(12, 18, 27) These studies evaluated face and content validity of the survey. Questions were  
137 re-worded to ask about rugby and *Activate*, rather than soccer and the *11+*. These amendments were face  
138 validated by the research team prior to administration. *Activate*-specific questions were aligned with the  
139 relevant RE-AIM dimensions, using the operationalised definitions presented in table 1 to facilitate  
140 interpretation. The survey consisted of single answer multiple choice questions, multiple answer multiple  
141 choice questions and scale/rank questions. Scale/rank questions were answered on a 7-point Likert scale, for  
142 example '*strongly agree*' to '*strongly disagree*'. To prevent bias towards the left of the scale,(28) Likert scales  
143 were reversed randomly throughout.  
144

145 *Activate* was not mentioned in recruitment correspondence to prevent bias in the 'awareness' questions.  
146 Gatekeepers were sent a link to the *Activate* website after completing the baseline survey as a coaching  
147 resource, but schools were not instructed to adopt the programme.  
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**Table 1.** RE-AIM dimension definitions

Dimension	RE-AIM Definition(21)	Operationalised Definition
<b>Reach</b>	<ul style="list-style-type: none"> <li>Proportion of target population that participated in the intervention</li> </ul>	<ul style="list-style-type: none"> <li>Percentage of coaches and players (end-users) aware of <i>Activate</i></li> </ul>
<b>Effectiveness</b>	<ul style="list-style-type: none"> <li>Success rate if implemented as intended</li> </ul>	<ul style="list-style-type: none"> <li>Perception that <i>Activate</i> reduced injury risk amongst end-users</li> </ul>
<b>Adoption</b>	<ul style="list-style-type: none"> <li>Proportion of settings and practices adopting the intervention</li> </ul>	<ul style="list-style-type: none"> <li>Percentage of coaches self-reporting using <i>Activate</i> (adoption and delivery to players)</li> <li>Percentage of players self-reporting using <i>Activate</i></li> </ul>
<b>Implementation</b>	<ul style="list-style-type: none"> <li>Extent to which the intervention is implemented as intended</li> </ul>	<ul style="list-style-type: none"> <li>Percentage of end-users using <i>Activate</i> as intended (adherence and fidelity)</li> </ul>
<b>Maintenance</b>	<ul style="list-style-type: none"> <li>Extent to which the programme is maintained over time</li> </ul>	<ul style="list-style-type: none"> <li>Perception that <i>Activate</i> could be maintained over multiple seasons</li> <li>Percentage of end-users intending to use <i>Activate</i> next season</li> </ul>

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**Post-season measures**

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**Analysis**

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Descriptive statistics were used to summarise continuous [mean, standard deviations (SD)] and discrete [percentages (%)] participant demographic data. Ordinal data collected from individual Likert scale responses were presented using medians, inter-quartile range (IQR), percentages (%) and confidence intervals (95% CI). Only participants who reported using *Activate* were included in the analysis of feedback relating to the programme.

Non-parametric Wilcoxon-Mann-Whitney tests used to assess differences between coach and player Likert scale responses. A 2x2 Chi-squared test ( $\chi^2$ ) was used to assess differences between groups for dichotomous responses (yes/no; 'unsure' responses were excluded from analysis). Statistical significance was accepted at a Bonferroni adjusted  $\alpha$  level  $p \leq 0.002$  (0.05/22 statistical tests) to reduce the risk of type I error.

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**RESULTS**

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**Demographics**

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Recruitment emails were sent to 289 schools (148 private, 141 state). At baseline, 106 coaches from 31 schools (11%; 25 private, 6 state) and 571 players from 23 schools (8%; 17 private, 6 state) responded to the survey (table 2).

**Table 2.** Participants' baseline characteristics

Question/demographic	Response	Coaches n (%)	Players n (%)
<b>School type</b>	Private (independent)	87 (82%)	393 (69%)
	State (government funded)	19 (18%)	178 (31%)
<b>Participant age</b>	Mean Age	37.4 ( $\pm$ 10.5)	15.3 ( $\pm$ 2.0)
<b>What is your role?</b>	Team staff	106 (100%)	-
	- Director of Sport	9 (8%)	-
	- Head coach/Director of rugby	41 (39%)	-
	- Assistant coach	36 (34%)	-
	- Team manager	13 (12%)	-
	- Conditioning coach	2 (2%)	-
	- Medical practitioner	5 (5%)	-
	Player	-	571 (100%)
<b>If coaching, how many years coaching experience do you have?</b>			
	Less than 2 years	13 (13%)	-
	2-3 years	10 (10%)	-
	4-5 years	11 (11%)	-
	6+ years	65 (66%)	-
<b>What is the highest level you have coached?</b>			
	School/Club	54 (55%)	-
	Regional Junior Academy	14 (14%)	-
	County/ constituent body	12 (12%)	-
	Divisional	8 (8%)	-
	Professional	3 (3%)	-
	International	7 (7%)	-
<b>What is the highest coaching qualification you hold?</b>			
	RFU Level 1	16 (18%)	-
	RFU Level 2	38 (42%)	-
	RFU Level 3	19 (21%)	-
	RFU Level 4	5 (5%)	-
	Other	13 (14%)	-
<b>When did you obtain this qualification?</b>			
	Less than 2 year ago	20 (26%)	-
	2-3 years ago	12 (16%)	-
	4-5 years ago	18 (23%)	-
	More than 5 years ago	27 (35%)	-
<b>What age group do you coach/play in?</b>			
	Under-12/13	16 (13%)	107 (19%)
	Under-14/15	34 (27%)	167 (29%)
	Under-16	9 (7%)	26 (5%)
	Under-18/19	42 (33%)	271 (47%)
	Multiple age groups	5 (4%)	-
<b>Have you previously played competitive rugby?</b>			
	No	9 (8%)	-
	Yes	97 (92%)	-
<b>If yes, what is the highest level you have played?</b>			
	School	12 (12%)	-
	Age group community club	4 (4%)	-
	Junior academy Rugby	3 (3%)	-
	University	11 (11%)	-
	Adult community club	47 (48%)	-
	Professional	13 (13%)	-
	International	7 (7%)	-
<b>Do you have a current medical or first aid qualification?</b>			
	No	30 (28%)	-
	Yes	76 (72%)	-

Have you ever used a specific programme to reduce your/players injury risk?		
No	65 (61%)	401 (70%)
Yes	41 (39%)	170 (30%)
In the past 12 months, have you experienced a rugby injury that caused you to miss a game or training session?		
No	-	244 (43%)
Yes	-	327 (57%)
If yes, did it cause you to miss school or work for at least 1 day?		
No	-	218 (67%)
Yes	-	109 (33%)

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### Perceptions

Coaches '*slightly agreed*' that rugby players are at high risk of injury, believing injuries have negative effects on team performance and long-term player health (table 3). Coaches (51% '*agreed*', 95% CI 41-61) held significantly stronger perceptions than players that rugby injuries could be prevented (45% '*agreed*', 95% CI 41-49;  $z=-3.3$ ,  $p\leq 0.001$ ). Most coaches '*strongly agreed*' that injury prevention exercises should be performed by rugby players, '*agreeing*' that a rugby specific warm-up could reduce injury risk while improving players' physical characteristics.

Pre-publication



248 **Table 3.** Baseline perceptions of coaches and players towards injury risk and injury prevention. Percentage  
 249 responding per answer (95% CI).  
 250

Statement...	Role	n	Median (IQR)	Strongly Agree			Neither		Strongly Disagree	
				1	2	3	4	5	6	7
<b>Rugby Injuries can...</b>										
...shorten a player's career	Coach	106	1 (1-2)	74% (66-82)	16% (9-23)	6% (1-11)	4% (0-8)	0% (-)	0% (-)	0% (-)
... cause physical problems later in life	Coach	106	1 (1-2)	61% (52-70)	28% (19-37)	10% (4-16)	1% (0-3)	0% (-)	0% (-)	0% (-)
... have a negative impact on team performance	Coach	106	2 (2-4)	21% (13-29)	37% (28-46)	14% (7-21)	12% (6-18)	5% (1-9)	7% (2-12)	6% (1-11)
... have a negative impact on a player's quality of life	Coach	106	2 (2-3)	21% (13-29)	40% (31-49)	23% (15-31)	4% (0-8)	7% (2-12)	3% (0-6)	2% (0-5)
Rugby players are at high risk of suffering an injury	Coach	106	3 (2-3)	15% (8-22)	33% (25-43)	29% (19-37)	8% (3-13)	9% (4-14)	3% (0-6)	2% (0-5)
	Player	571	3 (2-4)	9% (7-11)	34% (30-38)	28% (24-32)	10% (8-12)	9% (7-11)	7% (5-9)	3% (2-4)
I expect/a player I coach to sustain an injury sometime during the next season	Coach	105	3 (2-3)	15% (8-22)	34% (25-43)	28% (19-37)	8% (3-13)	5% (1-9)	9% (4-14)	1% (0-3)
	Player*	571	3 (3-5)	5% (3-7)	17% (14-20)	31% (27-35)	18% (15-21)	9% (7-11)	15% (12-18)	5% (3-7)
It is possible to prevent some rugby injuries	Coach	105	2 (1-2)	36% (27-45)	51% (41-61)	11% (5-17)	0% (-)	1% (0-3)	1% (0-3)	0% (-)
	Player*	571	2 (1-3)	26% (22-30)	45% (41-49)	22% (19-25)	2% (1-3)	2% (1-3)	3% (2-4)	0% (-)
<b>Exercises which have been shown to prevent injuries should be...</b>										
...performed by rugby players	Coach	106	1 (1-2)	52% (42-62)	45% (36-54)	3% (0-6)	0% (-)	0% (-)	0% (-)	0% (-)
	Player	571	2 (1-2)	50% (46-54)	42% (38-46)	5% (3-7)	2% (1-3)	1% (0-2)	0% (-)	0% (-)
...incorporated into schools' rugby training	Coach	106	2 (1-2)	44% (35-53)	43% (34-52)	4% (0-8)	0% (-)	1% (0-3)	0% (-)	8% (3-13)
... varied and progressed over time	Coach	106	2 (1-2)	43% (34-52)	47% (37-57)	6% (1-11)	4% (0-8)	0% (-)	0% (-)	0% (-)
<b>Completing a rugby specific warm-up programme prior to every game and training session will...</b>										
...reduce the risk of players sustaining an injury	Coach	106	2 (1-2)	35% (26-44)	48% (38-58)	15% (8-22)	2% (0-5)	1% (0-3)	0% (-)	0% (-)
	Player	571	2 (1-2)	44% (40-48)	42% (38-46)	10% (8-12)	2% (1-3)	2% (1-3)	0% (-)	0% (-)
... improve physical characteristics such as balance, agility and strength	Coach	106	2 (1-2)	29% (20-38)	48% (38-58)	12% (6-18)	4% (0-8)	2% (0-5)	1% (0-3)	4% (0-8)

251 Note: n=number of respondents per statement. IQR=inter-quartile range

252 \* $p < 0.001$  when assessing coach versus player responses

253

254 Significant differences existed between coaches and players when asked 'who is responsible for injury  
 255 prevention?' (figure 1). Both groups rated themselves highest (97%, 95% CI 94-100 and 87%, 95% CI 84-90  
 256 respectively). Coaches felt injury prevention was a collective responsibility across all roles, except team  
 257 managers (4%), whilst players thought responsibility was confined to themselves, head coaches and  
 258 conditioning staff (all remaining roles <30%).

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### 260 Reach and Adoption (baseline)

261 At baseline, most coaches were aware of *Activate* (75%, 95% CI 67-83; figure 2) but fewer than half reported  
 262 previous (48%, 95% CI 38-58) or current use (37%, 95% CI 28-46). Coach awareness largely came from peers  
 263 (45%, 95% CI 36-54), the RFU website (43%, 95% CI 33-52) and RFU community rugby coaches (24%, 95% CI 16-  
 264 32) who were employed by the RFU to support community schools and clubs.

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Significantly fewer players were aware of *Activate* at baseline than coaches (13%, 95% CI 10-16;  $\chi^2=173.5$ ,  $p<0.001$ ). A small percentage reported previously or currently using *Activate* (both 11%, 95% CI 8-14), with a large proportion unsure if they currently used the programme (46%, 95% CI 42-50). Player awareness mainly came from their coaches (77%, 95% CI 67-87), with all remaining options under 14%.

### **Effectiveness (post-season)**

Coaches with experience using *Activate* believed it could reduce injury risk (53% 'agreed', 95% CI 41-65; table 4). Adopting coaches held stronger perceptions it prevented injuries in their team (43% 'slightly agreed', 95% CI 30-56) than players (41% 'neutral', 95% CI 28-54;  $z=-3.3$ ,  $p<0.001$ ).

### **Adoption**

Coaches reported significantly greater adoption rates than players during the study period (76%, 95% CI 66-86; and 18%, 95% CI 14-22 respectively;  $\chi^2=41.8$ ,  $p<0.001$ ). Players were largely unaware whether they used *Activate* during the season (45%, 95% CI 39-50). All adopting coaches reported using the programme prior to training, though 16% (95% CI 6-25%) did not use it prior to matches.

### **Implementation**

Adopting coaches had a median adherence of two sessions per week (45%, 95% CI 32-58), with 33% (95% CI 21-45) using *Activate* thrice weekly as recommended. Median duration prior to training was 10-15 minutes (50%, 95% CI = 37-63), with 28% of coaches taking 15-20 minutes to complete *Activate* (95% CI 16-40). Adopting coaches reported median duration prior to matches was 10-15 minutes (31%, 95% CI 19-43), with a third spending 5-10 minutes (33%, 95% CI 21-45). Of adopting players, 41% (95% CI 28-54) reported completing 2 sessions per week (41%, 95% CI 28-54), with 33% (95% CI 21-46) using *Activate* three times per week. There was no difference between coach and player adherence ( $\chi^2= -0.1$ ,  $p=0.9$ ).

### **Maintenance**

Most coaches 'agreed' *Activate* contained adequate variations/progressions (55%, 95% CI 43-67) and could be maintained over multiple seasons (58%, 95% CI 46-70); however, 44% (95% CI 46-70) felt it needed to be improved and 47% (95% CI 35-59) suggested their school develop their own version. Coaches had significantly greater intention (43% 'strongly agreed', 43%, 95% CI 32-55) to use *Activate* next season than players (54% 'neutral', 95% CI 48-60;  $\chi^2= -5.5$ ,  $p<0.001$ ).

320 **Table 4.** Post-season perceptions from end-users who reported previous *Activate* use. Percentage responding  
 321 per answer (95% CI).  
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Statement:	RE-AIM	Role	n	Median (IQR)	Strongly Agree			Neither		Strongly Disagree	
					1	2	3	4	5	6	7
<i>Activate</i> can prevent rugby injuries in your team	E, A	Coach	62	2 (1-2)	26% (15-37)	53% (41-65)	15% (6-24)	3% (0-7)	0% (-)	0% (-)	3% (0-7)
<i>Activate</i> is rugby specific	A, I, M	Coach	62	3 (2-5)	15% (6-24)	16% (7-25)	24% (13-35)	18% (8-28)	13% (5-21)	13% (5-21)	2% (0-5)
		Player	57	4 (2-4)	11% (3-19)	23% (12-34)	16% (6-26)	28% (16-40)	5% (0-11)	12% (4-20)	5% (0-11)
<i>Activate</i> is too long	A, I, M	Coach	62	4 (3-6)	2% (0-5)	16% (7-25)	21% (11-31)	22% (12-32)	11% (3-19)	23% (13-33)	5% (0-10)
		Player	57	4 (3-5)	2% (0-6)	16% (6-26)	12% (4-20)	42% (29-55)	12% (4-20)	11% (3-19)	5% (0-11)
<i>Activate</i> was fun to do	A, I, M	Player	57	4 (3-4)	5% (0-11)	11% (3-19)	21% (10-32)	42% (29-55)	11% (3-19)	3% (0-7)	7% (0-14)
<i>Activate</i> contains adequate variation and progression for our team	A, I, M	Coach	62	2 (2-3)	3% (0-7)	55% (43-67)	27% (16-38)	7% (1-13)	8% (1-15)	0% (-)	0% (-)
<i>Activate</i> could be maintained over multiple seasons by our team	A, I, M	Coach	62	2 (2-3)	16% (7-25)	58% (46-70)	23% (13-33)	3% (0-7)	0% (-)	0% (-)	0% (-)
<i>Activate</i> reduced my/players injury risk this season	E, A, I, M	Coach	58	3 (2-4)	0% (-)	26% (15-37)	43% (30-56)	9% (2-16)	14% (5-23)	7% (0-14)	2% (0-6)
		Player*	54	4 (3-5)	6% (0-12)	4% (0-9)	17% (7-27)	41% (28-54)	22% (11-33)	7% (0-14)	4% (0-9)

323 Note: RE-AIM dimension; R=reach, E=effectiveness, A=adoption, I=implementation, M=maintenance.  
 324 n=number of respondents per statement. IQR=inter-quartile range  
 325 \* $p < 0.001$  when assessing coach versus player responses  
 326

### 327 Facilitators and Barriers

328 Coaches with experience using *Activate* (in this study or previously) perceived its positives to be '*learning*  
 329 *exercises to reduce my players' injury risk*' (73%, 95% CI 62-84), followed by '*completing exercises different to*  
 330 *usual rugby training*' (65%, 95% CI 53-77). The most commonly reported barrier from coaches was the lack of  
 331 ball work within the programme (45%, 95% CI 33-57). Nearly a third of coaches (31%, 95% CI 19-43) reported  
 332 that players disliking *Activate* was a barrier. Some coaches felt *Activate* limited their time to train (29%, 95% CI  
 333 18-40), 32% recommending reducing the programmes duration (95% CI 20-44).  
 334

335 There was no consensus from players regarding facilitators to using *Activate*. Commonly reported player  
 336 barriers were the lack of ball work (37%, 95% CI 24-50) and the resulting lack of time to train (28%, 95% CI 16-  
 337 40). Only 6% (95% CI 0-12) of players with *Activate* experience said they did not like completing the programme,  
 338 although 22% (95% CI 11-33) of players reported the exercises were boring.  
 339

### 340 DISCUSSION

341 This study sought to describe the knowledge and perceptions of schoolboy rugby coaches and players towards  
 342 injury risk, prevention and the *Activate* programme. Coaches had significantly greater perceptions of rugby  
 343 injury risk and more positive perceptions towards prevention than players. Coaches had high rates of *Activate*  
 344 awareness and adoption. Only a small percentage of players were aware of the programme, with their  
 345 awareness largely coming from their coaches. Coaches are critical stakeholders in the decision to adopt and  
 346 deliver *Activate* in a school context, suggesting implementation strategies should focus upon these individuals.  
 347

348 Coaches perceived rugby players were at high risk of injury, agreeing with evidence that injuries can have  
 349 detrimental effects on team performance,(30) an athlete's career(31) and their quality of life.(31, 32) Coaches  
 350 and players felt it was possible to prevent rugby injuries, identifying the positive effects rugby specific warm-  
 351 ups can have on injury risk.(1, 33, 34) These findings are encouraging as end-user knowledge and perceptions

352 influence outcome behaviour.(3, 35) However, influences on behaviour are multifactorial(18, 19, 36) and the  
353 notion that high levels of perceived risk or effectiveness will lead to coaches' adoption(6) or adherence(19) is  
354 too simplistic. Altering these perceptions should not be the primary strategy for maximising implementation.  
355 Utilising behaviour change theories, may provide success in influencing coach behaviour to maximise outcomes  
356 for the latter dimensions of RE-AIM.(18, 37)

357  
358 Using the RE-AIM framework, there was good programme reach amongst coaches. This is especially positive as  
359 this study was conducted within two years of *Activate*'s launch and more established programmes have  
360 reported poorer coach awareness.(13, 14, 27, 38) Players had poor programme awareness, likely not affecting  
361 their exposure in a school environment but hindering autonomous adoption and long-term maintenance.  
362 Coaches reported significantly greater adoption rates than players, many of whom were unaware they were  
363 completing *Activate*. This supports the notion that coaches have primary decision-making responsibility and  
364 control of injury prevention in youth sport(39) and directing effort towards behaviour change in these  
365 individuals should be a priority. This approach is further advocated given coaches impart their awareness of  
366 injury prevention programmes onto their players,(23) whilst positively influencing players' injury prevention  
367 behaviours.(40)

368  
369 Hislop et al(1) found greatest efficacy when completing *Activate* three times per week.(1) Coaches in this  
370 present study reported a median adherence of twice weekly. Similar programmes have found significant  
371 benefits when used two times per week(41) so this level of adherence may be sufficient to provide a  
372 preventative effect. However, *Activate*'s dose-response relationship needs investigation in future pragmatic  
373 trials. Coaches reported a median duration of 10-15 minutes to complete *Activate*, suggesting the programme  
374 was not implemented as intended. Low exercise fidelity in youth athletes, with players not completing all  
375 preventative exercises(38, 42) or performing them incorrectly,(42-44) has been reported in the literature. It is  
376 unclear whether the shorter duration noted in this study is related to issues regarding exercise fidelity, but  
377 further evaluation is warranted given the potential negative impact on effectiveness.

378  
379 Prevention programme maintenance is scarcely investigated,(25, 26, 45) leaving long-term effectiveness  
380 unexplored. Coaches agreed that *Activate* contains adequate variations and progressions to facilitate  
381 maintenance, contrasting findings from the 11+ where less than 50% of coaches and players felt the programme  
382 could be maintained for multiple seasons.(38) Uniquely, *Activate* can be progressed over weeks, months and  
383 seasons, with each age-specific programme containing four phases. This possibly influenced coaches' positive  
384 perceptions and this approach should be considered when developing future injury prevention programmes.

385  
386 Reduced training time as a result of completing *Activate* was a reported barrier from coaches and players.  
387 Similar barriers restricted 11+ adoption in community football.(18, 46) A recent study found completing 11+  
388 strengthening exercises (part 2) post-session increased adherence without negatively influencing  
389 effectiveness.(47) Before this approach can be advocated for *Activate*, research needs to explore the  
390 mechanistic effect of the programme. Certain exercises were included to reduce specific injuries (e.g., isometric  
391 neck strengthening for concussion). If these exercises induce chronic long-term effects, they could be omitted  
392 from the warm-up and completed at a more suitable time. Conversely, if they induce acute physiological effects,  
393 they likely need to be completed immediately prior to exposure. Until this is established it would not be  
394 appropriate to recommend completing specific parts, or exercises, post-session as a preventative measure.

### 395 396 **Limitations**

397 To mitigate selection bias, the recruitment database was expanded to include 252 additional schools who did  
398 not participate in the efficacy study.(1) In total, 30% of participating schools in this study were involved in the  
399 efficacy study. It is unknown if coaches themselves participated in the previous study. At the time, the  
400 programme was not called *Activate* and it is unclear if previous participation would have influenced coaches'  
401 awareness or perceptions towards the programme. A large proportion of respondents were from independent  
402 schools despite targeting an equal number of state schools in the recruitment process. Beyond school type, no  
403 further demographic information is available for non-respondents, reducing the generalisability of the results  
404 and increasing the risk of selection bias.

405

406 Surveys administered were an amalgamation of those previously used in football(12, 18, 19, 27) and rugby.(1,  
407 29) They have not been psychometrically evaluated beyond face and content validity. Post-season surveys were  
408 completed within 6 months of the end of the season to reduce recall bias.(48) A 7-point Likert scale was used  
409 to minimise the effect of any central tendency bias.(49) Surveys provided no option for free-text answers.  
410 Utilising qualitative methods may provide greater insight into end-user perceptions and contextual issues.

411

#### 412 **CONCLUSIONS**

413 This study provides novel findings regarding the implementation of the *Activate* injury prevention exercise  
414 programme in English schoolboy rugby. Coaches had significantly greater awareness and adoption of *Activate*,  
415 with players largely unaware of the programme and if they used it. Coaches appear key stakeholders in the  
416 decision to implement *Activate* in a school rugby environment. Focus on behaviour change in coaches should  
417 be a priority to maximise *Activate* uptake.

418

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422

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424 CB completed this study as part of his PhD, which is funded by the Rugby Football Union. KAS is the medical  
425 research lead for the Rugby Football Union.

426

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429

#### 430 **CONTRIBUTORS**

431 CB conceived the initial study concept, with CM and KAS providing input into the study design and  
432 methodology. CB collected and analysed the data, drafting the initial manuscript. Critical revisions were made  
433 to the manuscript by CM and KAS. All authors approved the final submitted manuscript.

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- 559



560 **FIGURE LEGENDS**

561

562 **Figure 1.** Baseline coach and player response to 'who is responsible for injury prevention'?

563 \* $p < 0.001$  when assessing coach versus player responses.

564

565 **Figure 2.** Baseline coach and player responses to *Activate* awareness and adoption. Percentage responding  
566 per answer (95% CI).

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